A.—TRUE TUMORS.

CLASS I.—*Teratoma*—Tumors developed from the three layers of the blastoderm. — Fœtal inclusions. / Dermoid cysts.

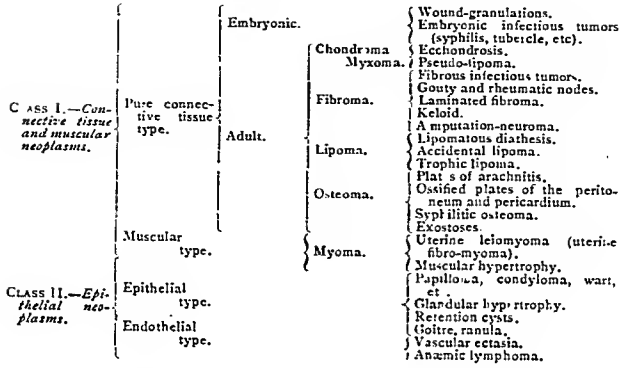
CLASS II. *Mixed Tumors*—Tumors developed from two layers or from the various elements of one.

- Ento- or ectomesodermic tumors. — Mixed epithelioma.
  - Chondromatous (chondrocarcinoma.
  - Myomatous.
  - Myxomatous.
  - Sarcomatous (cystosarcoma).
  - Lipomatous.
- Mixed mesodermic tumors. — Mixed enothelioma.
  - Chondromatous (chondrosarcoma).
  - Myxomatous myxosarcoma).
  - Myomatous (myosarcoma).
  - Lipomatous.

CLASS III.—*Pure Tumors*—Tumors developed from a single layer of the blastoderm.

- Ectodermic Tumors.
  - Epithelial type.
    - Typical epithelioma.
      - Adenoma or papilloma.
        - Glandular adenoma.
        - Corneous papilloma.
      - Pavement epithelioma
        - Lobular ——
        - Pearly ——
        - Papillary ——
        - Tubular ——
        - Glandular ——
        - Keratinized ——
    - Metatypical epithelioma.
      - Encephaloid carcinoma.
      - Scirrhous ——
      - Hæmatoid ——
      - Reticulated ——
  - Adult or differentiated type.
    - Neuroma.
      - Myelinic neuroma.
      - Amyelinic neurom .
- Entodermic Tumors.
  - Epithelial Type.
    - Typical epithelioma.
      - Adenoma or papilloma.
        - Adenoma or papilloma of the intestine and its annexes.
      - Cylindrical epithelioma of the intestine, the stomach, the liver, the kidney, the testicle and the ovary.
      - Mucoid epithelioma.
    - Metatypical epithelioma.
      - Carcinoma of the same organs.
- Mesodermic tumors.
  - Endothelial type.
    - Typical endothelioma.
      - Angioma or plexiform lymphangioma.
      - Angioma or papilloma.
        - Papilloma of serous membranes
      - Angiolithic sarcoma.
      - Angiosarcoma.
      - Myeloplaxic sarcoma.
      - Lymphangio sarcoma.
      - Lymphadenoma.
      - Cylindroma.
      - Endothelioma.
      - Endothelial sarcoma.
      - Melanotic sarcoma of the eye
    - Metatypical endothelioma
      - Lymphosarcoma.
      - Diffuse melanotic sarcoma.
      - Myxosarcoma.
      - Glioma.
  - Adult or differentiated type.
    - Connective tissue type.
      - Chondroma.
      - Lipoma.
      - Myxoma.
      - Fibroma.
    - Muscular typ .
      - Rhabdomyoma.
      - Leiomyoma.

B.—INFLAMMATORY OR TROPHIC NEOPLASMS.



Now, having indicated in a general way the various phases through which the history of the origin of tumors has passed and what more precise and satisfactory ideas we have acquired at the present day, it remains for us to apply these to tumors of the testicle. The study will properly begin with the consideration of the more complex tumors, since the theoretical plan for our guidance being provided, an examination of the clearly congenital types will assist us in comprehending the true nature of tumors of more simple structure but of less evident etiology. In this particular case, however, beginning with complex and ending with pure tumors is really proceeding from the simple to the compound; it is, in fact, passing from the admitted and demonstrated, by an insensible transition the steps of which will be noted, to a conclusion which might *a priori* have appeared untenable—the identity of origin of all true tumors of the testicle.

Complex tumors of the testicle are of two classes:

1. Various congenital cystic formations of which inclusions affecting the testicle and scrotum are the highest type, and dermoid cysts the most rudimentary form.

2. Mixed tumors, with or without cystic formation, composed of two or three fundamental tissues more or less blended in the same neoplastic mass.

It is purposed to demonstrate a common origin for these two classes of tumors in the testicle and then to show how the third class of pure tumors may itself be allied to the others.

I. FŒTAL INCLUSIONS. DERMOID CYSTS. TERATOMAS.—The complicated teratological productions known as fœtal inclusions are especially found developed in the testicle and the more often in relation with the gland, but not from it. They should be allied with dermoid cysts; in fact. upon passing in review the published cases, it will be observed that in these inclusions are the more often found only complex masses formed of various tissues presenting a rude outline of organization, but ordinarily having but slight resemblance to fœtal debris. The tumor is most always reduced to a cyst more or less compound, containing hairs, fleshy masses and ossified parts, sometimes real bone.

Between these tumors and dermoid cysts then, there is but a difference of degree, and to show this analogy it is proposed to unite them in a class under the name of teratoma, a name excellently suggesting the relationship with the teratological cases to which they are so nearly related.

The embryonic origin of these tumors is almost universally admitted, and their pathogeny, following the views previously advanced, should be referred to a vice of development of the blastodermic layers, to the isolation within tissues in the process of formation, of a small mass detached from these layers and possibly composed of many elements. These embryonic masses pursue their evolution with a rudimentary organization sometimes forming organs and fragments of organs, but never constituting a complete organic system.

The very great complexity of these tumors would seem to indicate that the more often the three blastodermic layers participate in their formation. This may readily occur if they originate in the first days of intra-uterine life at the moment of the formation of the genital organism, *i. e.*, at an epoch when there can be observed in the caudal region of the embryo an almost physiological fusion of the three layers. This circumstance is doubtless eminently favorable to division and separation of an isolated fragment composed of elements derived

from each of them. Thus in these tumors, when completely developed, may be found either connective and muscular tissues, if the middle layer is included in the invagination; or cartilage and bone if the provertebræ have been involved in the inclusion; or epithelial debris of a cylindrical or pave-type, according as the endoderm or ectoderm is concerned.

From this standpoint it can be seen that there is no real difference between inclusions and dermoid cysts; in fact, it is possible to find by minute analysis of cases intermediate types from the tumor by inclusion—the contents of which resemble a veritable fœtus—to the common dermoid cyst, consisting of a dermo-epidermic wall circumscribing a cavity with pilo-sebaceous contents. Moreover, in the more simple dermoid tumors, a complete examination will almost always discover some more complex part resembling the structure of tumors by inclusion.

II. MIXED TUMORS.—In a similar way, it is possible to discover between teratomas and mixed tumors a relationship analogous to that between dermoid cysts and inclusions. Mixed tumors of the seminal gland are productions complicated in structure, which cannot for this reason be ranged in any of the grand classes of neoplasms admitted by pathologists; in them are found the most various tissues; epithelial cells arranged as in true carcinoma, embryonic elements analogous to those of carcinoma, cartilaginous tissues as in enchondroma, cysts of variable epithelial contents and covering, sometimes veritable osseous tissue, striated and non-striated muscular fibres, and even nervous tissue.

The existence in dermoid cysts of a cystic cavity ordinarily monocular and considerable, is not sufficient to completely differentiate them. This is due simply to some accessory circumstance as yet unknown, but which does not modify the intrinsic nature of the tumor. The almost necessary presence of pavement epithelium and its derivatives in dermoid cysts and inclusions, while it is almost constantly absent in mixed tumors, constitutes a differential characteristic which would seem to be very important; it is impossible, however, to found the establishment of two entirely distinct categories of tumors upon this

fact alone. It is evident then that there are no essential differences between the structure of mixed tumors and that of teratomas; there are in both the same anatomical elements more or less varied and blended.

If then there really exists a close relationship between mixed tumors and teratomas, the natural conclusion would be that their origin is identical. How, moreover, can the union in the same mass, of elements so varied as those composing mixed tumors of the testicle, be explained without going back to the embryonic period where these elements originated?

When trouble supervenes in normal evolution and this at a point where, as has just been mentioned, the blastodermic layers are almost blended, and when this point of fusion is at the same time near that where the first vestige of the seminal gland appears, it is easy to understand that an isolated cellular mass detached from the embryonic tissue could be buried in the gland itself or its immediate neighborhood and later become the point of departure of a mixed tumor. It is probable, however, that this separation occurs at a little earlier period than does that of teratoma, and at a time when there is more distinction between the blastodermic layers, for the study of these tumors in the great majority of cases shows the elements of but two of these layers or even but one of them.

When the inclusion, and this is the most frequent case, affects the different parts of the middle layer or the parts derived but separated from the internal layer, the tumors developed are mixed enchondromas, sarcomas with cartilaginous kernels, mixed carcinomas and myomas of heterogeneous structure so frequent in the seminal gland. The inclusion of a Pfluger's tube will give rise to an epithelial neoplasm, but the tumor will rarely be pure, some cells either from the provertebræ or the lateral plates in the form of cartilaginous nuclei, or some masses of striated or non-striated muscular fibre in process of development are found here. In the same way sarcomas developed from endothelial elements, might contain pearls of cartilage, muscular fibres, and typical and atypical epithelial productions. And it is evident that the theory of Cohnheim permits us to understand the formation of as many vari-

eties as there are possible combinations between the different elements of the middle layer and the neighboring layers.

A review of the literature of tumors of the testicle shows that almost all of them are mixed. True chondroma is the exception, pure myoma is doubtful, pure sarcoma and carcinoma are far from common, and the most frequently the various tissues combine to form a variety of tumors, the existence of which our theory enables us to foresee.

III. PURE TUMORS. The pure tumors form the third and last class of the neoplasms which we have undertaken to classify. Two groups can be distinguished *a priori*: A. Those developed from the elements of the middle layer; B. Those developed from the internal layer and its derivatives.

A.—The tumors, the origin of which may be referred to the middle layer, are chondroma, myxoma, embryonic sarcoma, angioma, lymphangioma and myoma. All have been found in the seminal gland, but they are relatively rare there, at least without a mixture of heterogeneous parts. It could even be held that certain of them, considered as practically pure tumors because the foreign elements associated with the fundamental substances of the neoplasm are so limited in quantity that they often pass unperceived. should really be called mixed tumors, because of the presence of those elements.

It has already been noticed that pure chondroma of the testicle is exceptional, if indeed any cases are on record. Tumors of the muscular type, rhabdomyoma, leiomyoma, fibromyoma, are perhaps still more so. Sarcomatous tumors are much more frequent, for giant-celled sarcoma, adult angioma, and spindle- and round-celled sarcoma with all their varieties have been observed there.

All these tumors arise from the middle layer and their embryonic origin can be established by a reasoning analogous to that employed in connection with mixed tumors. It was shown that an evident analogy existed between teratoma and mixed tumor, and that intermediate types connecting them could be found, so that to the latter may be applied the hypothesis of embryonic origin, which is indisputable with the former. Now, between pure and mixed tumor, the stages of transition are still more numerous; the fact alone that it is sometimes difficult

to distinguish them from one another would seem to demonstrate this relation *a priori*. It would then be proper to suppose from this fact alone that the origin of these classes, so closely connected, is the same.

But still other evidences of the embryonic origin of this group exist. Chondroma, myxoma, myoma and in particular sarcoma often present a very clear embryonic structure. There may be cartilaginous kernels formed of fœtal cartilage; certain muscular tumors contain striated fibres in course of development: the giant cells observed in certain sarcomas are simply embryonic vaso-formative cells.

The hypothesis that, under the influence of inflammation and a diathesis, the tissues resume the embryonic type is certainly less rational than the theory of Cohnheim, that buried and quiescent elements have resumed their interrupted evolution and pursue their development from the point where it was arrested. They present successively all the phases of normal growth, and microscopical examination of a tumor finds it at one of the periods of this organization.

In this way the distinct differences clinically separating the various productions enumerated can be explained. The nearer the tissues contained in a neoplasm approach the adult state, *i. e.*, the later the inclusion has occurred, the more benign is the clinical course. This is true of adult fibroma, lipoma and angioma; but in the contrary condition the progress of the growth is that of a malignant tumor, sarcoma, lymphadenoma, etc.

The hypothesis of Cohnheim then expresses the truth concerning mesodermic tumors as well as those previously studied.

B.—The entodermic tumors, developed from the internal blastodermic layer, are the epithelial tumors proper. They and mixed tumors are the most frequent in the testicle.

Epithelial tumors, by reason of their structure and evolution present two forms; the typical form, resembling more or less in disposition normal glandular tissue; and the metatypical form or carcinoma. Both of these forms may be shown to exist in the testicle.

The "typical" form of epithelioma of the testicle is represented in cystic disease of that organ. Malassez has demonstrated the complete

analogy between cystic disease of the testicle and cystic degeneration of the ovary; both are entitled by reason of the disposition of the epithelium which lines the cavity of the tumor, to the name given them by Malassez, mucoid epithelioma. Now mucoid epithelioma of the ovary being considered as a typical epithelioma, it is clear that cystic disease of the testicle belongs to the same category. These two forms of degeneration of the male and female glands evidently correspond to typical glandular epithelioma of the intestinal canal.

The "atypical" epithelial tumors of the testicle assume various forms, some of which greatly resemble cystic disease. The majority of the cases formerly described as cystic sarcoma, and almost all the cysto-adenomas of certain authors, were but more advanced phases of the more atypical modalities of cystic disease.

The true "metatypical" epithelioma (carcinoma) is more common. It is more often a very diffuse tumor, absolutely atypical throughout with a small amount of stroma and subject to mucoid and colloid degenerations, to partial gangrene and to multiple hæmorrhage. This form corresponds to the encephaloid tumor of old authors.

The scirrhous variety with dense stroma and few cellular elements is more rare. It is often accompanied by the formation of epidermic pearls resulting from the involution of canalicular epithelium.

In this class of tumors, the most varied appearances may be observed either from the relatively varying amount of stroma and cells or from secondary degenerations produced in the neoplastic tissue. The stroma is sometimes clearly reticulated (reticulated carcinoma). In other cases, melanotic infiltration of a greater or less part of the mass might cause it to be mistaken for a true melanotic carcinoma, the existence of which in the testicle is very doubtful. Degeneration causes other conditions. The destruction of a certain amount of the contents and dilatation of the capillaries of the stroma produces bloody lacunæ and the tumor becomes essentially vascular, forming hæmatoid carcinoma of the testicle. The neoplasm may undergo a caseous and mucoid degeneration altering its aspect to such an extent that anatomical diagnosis becomes almost impossible. But these secondary variations are without importance from the standpoint of the

classification of the tumors, for it is almost always possible to refer back to the original type and to range them in their proper place in the list of epithelial tumors.

By arguments similar to those employed in connection with mesodermic tumors, the embryonic origin of this group can be shown, but it is not necessary to repeat them. It will be sufficient to remark that it is susceptible of ample demonstration.

Then, since complex tumors of the testicle clearly have a congenital origin, and since no absolutely differential characteristic between complex and pure tumors can be found, we are forced to the conclusion that all true tumors of the testicle are products referable to a vice of embryonic development. Relying upon this fact then, Messrs. Monod and Arthraud have deduced the following rational classification of neoplasms of the genital gland.

- **Class I.—*Teratomas*—Tumors developed from the three layers of the blastoderm.**
  - Fœtal inclusion.
  - Dermoid cyst.
- **Class II. *Mixed Tumors.*—Tumors developed from two layers or from elements of one only.**
  - Endo- or ecto-mesodermic tumors.
    - Typical or atypical epithelioma.
      - Sarcomatous.
      - Myxomatous.
      - Chondromatous.
      - Myomatous.
      - Lipomatous.
  - Mesodermic tumors.
    - Typical or atypical endothelioma.
      - Chondromatous.
      - Myomatous.
      - Myxomatous.
      - Lipomatous.
- **Class III. *Pure Tumors.***
  - 1st group (B). Tumor developed from the internal layer or its derivatives (endodermic tumors).
    - Adenoma
      - Typical epithelioma
        - Benign form of cystic disease
        - Typical mucoid epithelioma.
        - Cystic sarcoma of the old authors.
      - Metatypical epithelioma
        - Reticulated carcinooma.
        - Colloid —
        - Hæmatoid —
        - Melanotic —
  - 2d group (A). Tumors developed from the middle layer/mesodermic tumors.
    - Endothelial type.
      - Rugioma.
        - Angioma and plexiform angioma.
      - Typical endothelioma
        - Embryonic angioma or myeoplaxic sarcoma.
        - Lymphangio-sarcoma.
        - Lymphadenoma.
        - Lymphoma.
      - Metatypical endothelioma (sarcoma)
        - mbryonic or spindle-celled sarcoma.
        - Lymphosarcoma.
        - Metatypical nulear eodothelioma.
    - Adolt or differenuated type.
      - Connective tumors.
        - Chondroma.
        - Myxoma.
        - Lipoma.
        - Fibroma.
      - Muscular tumors.
        - Rhabdomyoma.
        - Leiomyoma.

This classification has not only the merit of grouping in a methodical manner the cases known at present, but it also has the immense advantage of foreseeing the existence of forms not yet described, and permitting us to connect to one another by a rational classification the scattered cases, the difficult interpretation of which has frequently caused their value to be misunderstood. It is far from being in accord with received ideas, but it is believed that later study of specimens, made in the light of the theoretical ideas advanced, will justify the general arrangement.

JAMES E. PILCHER.